

## WHAT IS CLAIMED IS:

1. A method of operating a power generation system comprising:

coupling at least one electrical generator to at least one prime mover, wherein at least one generator includes at least one of a stator and a rotor wherein at least one of the stator and the rotor includes superconducting windings therein; and

coupling at least one cryogenic refrigeration system to the superconducting windings, the at least one cryogenic refrigeration system coupled in flow communication with the superconducting windings to facilitate reducing an operating temperature of the superconducting windings.

2. A method in accordance with Claim 1 further comprising:

coupling a cryogenic fluid transfer coupling in flow communication with the rotor superconducting windings to route cryogenic fluid to the rotor superconducting windings; and

coupling the cryogenic fluid transfer coupling in flow communication with the at least one cryogenic refrigeration system.

3. A method in accordance with Claim 1 further comprising:

operating the generator as a synchronous condenser;

coupling the generator, operating as a synchronous condenser, electrically to the power generation system, the synchronous condenser including at least one of superconducting stator windings, and superconducting rotor windings;

coupling the synchronous condenser superconducting windings in flow communication with the at least one cryogenic refrigeration system.

4. A method in accordance with Claim 1 wherein coupling at least one electrical generator to at least one prime mover comprises coupling at least one electrical generator to at least one of a turbine assembly, and an internal combustion engine assembly.

5. A method in accordance with Claim 4 wherein said method further comprises coupling a steam turbine assembly in flow communication with at least one of a HRSG, a fossil fuel-fired boiler, a waste-fired boiler, a biomass-fired boiler, a geothermal source, a solar source, and a nuclear reactor.

6. A method in accordance with Claim 4 wherein coupling at least one electrical generator to at least one prime mover comprises coupling a plurality of prime movers in cross-compound configuration.

7. A method in accordance with Claim 4 further comprising:

coupling at least one HRSG to at least one of an exhaust of the at least one prime mover, a solar collector, a geothermal source, an an exothermic industrial process; and

transferring heat from the exhaust of the prime mover to the HRSG.

8. A method in accordance with Claim 7 further comprising coupling a steam side of the at least one HRSG in flow communication with at least one steam turbine in a combined cycle configuration.

9. A method in accordance with Claim 1 wherein coupling at least one electrical generator to at least one prime mover comprises coupling a plurality of prime movers in tandem.

10. A method in accordance with Claim 1 wherein coupling at least one electrical generator to at least one prime mover further comprises coupling the at least one electrical generator to a plurality of primary shafts, wherein each shaft is coupled to at least one prime mover.

11. A power generation system comprising:

at least one prime mover;

at least one electrical generator rotatably coupled to said at least one prime mover, said generator comprising at least one of a stator and a rotor wherein at

least one of said stator and said rotor comprises superconducting windings therein; and

at least one cryogenic refrigeration system in flow communication with said superconducting windings to facilitate reducing an operating temperature of said superconducting windings.

12. A power generation system in accordance with Claim 11 wherein said at least one electrical generator further comprises:

a cryogenic transfer coupling coupled to said rotor, said coupling in flow communication with said rotor superconducting windings and said at least one cryogenic refrigeration system.

13. A power generation system in accordance with Claim 11 further comprising a synchronous condenser comprising at least one of superconducting stator windings and superconducting rotor windings, said synchronous condenser electrically coupled to said power generation system, said superconducting windings coupled in flow communication with said at least one cryogenic refrigeration system.

14. A power generation system in accordance with Claim 11 wherein said at least one prime mover comprises at least one of a turbine assembly and an internal combustion engine assembly.

15. A power generation system in accordance with Claim 14 wherein said at least one prime mover comprises a steam turbine in flow communication with at least one of a heat recovery steam generator (HRSG), a fossil fuel-fired boiler, a waste-fired boiler, a biomass-fired boiler, a geothermal source, a solar source, and a nuclear reactor.

16. A power generation system in accordance with Claim 11 wherein said at least one prime mover comprises a plurality of prime movers rotatably coupled.

17. A power generation system in accordance with Claim 11 wherein said at least one prime mover comprises a plurality of prime movers in a coupled cross-compound configuration.

18. A power generation system in accordance with Claim 11 further comprising at least one HRSG, said at least one prime mover is coupled in flow communication with said HRSG.

19. A power generation system in accordance with Claim 18 wherein a steam side of said at least one HRSG is coupled in flow communication with at least one steam turbine in a combined cycle configuration.

20. A power generation system in accordance with Claim 11 that further comprises a plurality of shafts, wherein at least one of said plurality of shafts is coupled to a superconducting generator, and at least one of said plurality of shafts is coupled to at least one of said at least one prime movers.

21. A power generation system in accordance with Claim 11 that further comprises at least one generator step-up transformer (GSU) comprising at least one superconducting windings therein.

22. A power generation system comprising:

at least one prime mover;

at least one electrical generator rotatably coupled to said at least one prime mover;

at least one GSU comprising at least one superconducting winding therein, said GSU electrically coupled to said electrical generator output; and

at least one cryogenic refrigeration system in flow communication with said superconducting windings to facilitate reducing an operating temperature of said superconducting windings.